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Foil-Terminated Free Wave Acceleration*

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We present theoretical and simulation results on a modification of the free wave accelerator concept.[1] It is well known that real acceleration of a charged particle in the presence of an electromagnetic wave is impossible, if all the criteria of the Lawson-Woodward theorem are satisfied. However, if one or more of the criteria are broken, it may be possible to use intense laser beams to accelerate charged particles to very high energies. We present a scheme in which the criterion requiring vacuum EM wave propagation is broken. In particular, a thin foil is placed at the focus of the laser beam. Particles are accelerated on their way to the foil, obtaining maximium energy near the focus. If the foil is not present, the particles would then lose their energy back to the EM wave, as they pass through the focus. However, we place the thin foil at the focus to disrupt the laser beam. In this manner, the particle preserves the energy it has gained on its way to the focus, since there is no EM field present behind the foil. Many questions about this scheme have been addressed via particle in cell simulations. Namely, effects of the reflected wave on the particles on energy gain and emittance, as well as various configurations of the EM wave will be discussed.

1. See for example, E. Esarey et al., this conference, or W. B. Mori and T. Katsouleas Proceedings of the Advanced Accelerator Concepts, AIP, Lake Geneva, WI, editor P. Schoessow (1995).

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